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Parallel transport in the scrape-off layer and the wall region of the TCV tokamak

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Experimental investigations and modelling of plasma transport in tokamak edge region contributes to better understanding of plasma processes and motions in the edge, especially to knowledge of radial transport that is not well-understood yet and is generally accepted to be due to a plasma turbulence. The presented work aims to contribute to the topic of edge plasma simulations and our computational study combines modelling of classical transport of the edge plasma along magnetic field and perpendicular transport that is simplified in the form of a diffusion.

A one-dimensional fluid code describing plasma transport in the scrape-off layer has been developed [1]. It solves a set of Braginskii-like equations for electrons and ions along magnetic field lines and assumes ambipolarity and no net current. Classical transport coefficients are used. Plasma-neutrals collisions are taken into account and neutrals are treated as a separate fluid. Cross-field transport constitutes a source of mass and energy for the one-dimensional computational region and is an input of the code.

The one-dimensional model is applied on a computational domain consisting of a number of one-dimensional field lines coupled together by cross-field transport. The transport perpendicular to field lines is approximated by the diffusion equation using an effective diffusivity. Typical conditions as found in a TCV tokamak discharge were assumed together with data for the cross-field transport obtained from experimental observations and a numerical simulation [2]. A motivation of the presented semi two-dimensional approach is to test the applicability of the one-dimensional fluid model for future coupling with turbulence code ESEL [3] that will replace presently used diffusive cross-field model and will provide time-dependent cross-field transport data. On the other hand, the parallel transport model will be used for time-dependent calculation of parallel losses of mass and energy to divertor targets in ESEL and will replace currently implemented analytic model of parallel transport [4] valid for steady-state simple SOL only.

[1] E. Havlickova, Ph.D. thesis, Charles University, Prague, 2009 (to be submitted)

[2] O. E. Garcia et al., Nucl. Fusion 47, 677 (2007)

[3] O. E. Garcia et al., Plasma Phys. Control. Fusion 48, L1 (2006)

[4] W. Fundamenski et al., Nucl. Fusion 47, 417 (2007)